

1 **CLAIMS**

2 1. A processor-readable medium comprising processor-executable
3 instructions for:

4 sending test data to a plurality of clients;
5 receiving a rate R_i which is based at least in part on a rate at which the test
6 data was received by at least some of the plurality of clients; and
7 calculating a rate R_0 at which to send an image to the plurality of clients,
8 wherein the rate R_0 is a function of at least some of the R_i .

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10 2. The processor-readable medium as recited in claim 1, wherein
11 sending test data comprises instructions for sending test data to the plurality of
12 clients by operation of a reliable multicast session.

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14 3. The processor-readable medium as recited in claim 1, wherein
15 sending test data comprises instructions for:

16 sending an initial transmission of test data;
17 setting a timer; and
18 sending additional test data until the timer expires.

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20 4. The processor-readable medium as recited in claim 1, wherein
21 sending test data comprises instructions for sending a portion of the image at an
22 initial transfer rate.

1 5. The processor-readable medium as recited in claim 1, wherein
2 sending test data comprises instructions for:

3 sending a first portion of the image at a first rate; and

4 sending a second portion of the image at a second rate.

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6 6. The processor-readable medium as recited in claim 1, wherein
7 sending test data comprises instructions for varying an amount of test data sent to
8 balance reliability and cost.

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10 7. The processor-readable medium as recited in claim 1, wherein
11 receiving the rate R_i comprises instructions for receiving a UDP packet from the at
12 least some of the plurality of clients.

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14 8. The processor-readable medium as recited in claim 1, wherein
15 receiving the rate R_i comprises instructions for receiving data-transfer statistics
16 from the at least some of the plurality of clients.

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1 9. The processor-readable medium as recited in claim 1, wherein
2 receiving the rate R_i comprises instructions for:

3 setting a timer to indicate a maximum period of time during which to wait
4 for a response from the plurality of clients; and

5 receiving data-transfer statistics from the at least some of the plurality of
6 clients within the maximum period.

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8 10. The processor-readable medium as recited in claim 1, wherein
9 calculating the rate R_0 comprises instructions for setting R_0 as a function of a
10 minimal value of the rate R_i for all i .

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12 11. The processor-readable medium as recited in claim 1, wherein
13 calculating the rate R_0 comprises instructions for:

14 dividing the plurality of clients into at least two groups; and
15 setting R_0 equal to a minimum R_i associated with clients within one of the at
16 least two groups.

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18 12. The processor-readable medium as recited in claim 1, wherein
19 calculating the rate R_0 comprises instructions for:

20 selecting one of the R_i ; and
21 setting R_0 equal to the selected R_i , less a de-rating factor.

1 **13.** The processor-readable medium as recited in claim 12, wherein
2 selecting one of the R_i comprises instructions for:

3 forming at least two groups of clients; and
4 selecting the smallest R_i associated with a client from within the at least two
5 groups of clients.

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7 **14.** The processor-readable medium as recited in claim 1, additionally
8 comprising instructions for sending the image at the rate R_0 during a first multicast
9 session.

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11 **15.** The processor-readable medium as recited in claim 14, additionally
12 comprising instructions for:

13 opening a second multicast session; and
14 sending the image at a rate less than R_0 in the second multicast session.

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16 **16.** A processor-readable medium comprising processor-executable
17 instructions for:

18 receiving test data from a server;
19 calculating a value for R_i based at least in part on a rate at which the test
20 data was received; and
21 sending the rate R_i to the server.

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23 **17.** The processor-readable medium as recited in claim 16, wherein the
24 test data was received during a reliable multicast session.

1 **18.** The processor-readable medium as recited in claim 16, wherein
2 receiving the test data comprises instructions for:

- 3 receiving an initial transmission of test data;
4 setting a timer; and
5 receiving additional test data until the timer expires.

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7 **19.** The processor-readable medium as recited in claim 16, wherein
8 receiving the test data comprises instructions for receiving a portion of the image
9 at an initial transfer rate.

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11 **20.** The processor-readable medium as recited in claim 16, wherein
12 receiving the test data comprises instructions for:

- 13 decrypting and decompressing the initial transmission of test data; and
14 writing the decrypted and decompressed test data to a disk.

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16 **21.** The processor-readable medium as recited in claim 16, wherein
17 sending the R_i comprises instructions for sending a UDP packet to the server.

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19 **22.** The processor-readable medium as recited in claim 16, wherein
20 sending the rate R_i comprises instructions for sending data-transfer statistics
21 including the rate R_i to the server in a UDP packet.

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23 **23.** The processor-readable medium as recited in claim 16, wherein
24 calculating the rate R_i comprises instructions for setting the rate R_i equal to an
25 average rate at which data was received.

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2 **24.** The processor-readable medium as recited in claim 16, wherein
3 calculating the rate R_i comprises instructions for setting rate R_i equal to a
4 minimum rate at which data was received.

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6 **25.** The processor-readable medium as recited in claim 16, wherein
7 calculating the rate R_i comprises instructions for:

8 setting the rate R_i as a function of the rate at which data was received; and
9 de-rating the rate R_i to result in a safer value.

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11 **26.** The processor-readable medium as recited in claim 16, additionally
12 comprising instructions for receiving an image at a rate R_0 during a first multicast
13 session if R_0 is less than R_i .

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15 **27.** The processor-readable medium as recited in claim 26, additionally
16 comprising instructions for receiving the image during a second multicast session
17 if R_0 is more than R_i .

1 **28.** A method for determining a transfer rate to multicast an image,
2 comprising:
3 sending test data from a server to a plurality of clients;

4 calculating R_i values for at least some of the plurality of clients based at
5 least in part on rate of receipt of the test date;

6 sending the R_i values from each of the plurality of clients to the server; and

7 calculating a rate R_0 at which to send an image from the server to the
8 plurality of clients, wherein the rate R_0 is a function based at least in part on at
9 least some of the R_i values.

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11 **29.** The method as recited in claim 28, wherein the test data is sent over
12 a reliable multicast session.

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14 **30.** The method as recited in claim 28, wherein sending test data
15 comprises:

16 sending an initial transmission of test data from the server;

17 setting a timer on the server;

18 receiving the initial transmission of the test data on each client;

19 setting a timer on each client;

20 sending additional test data until the timer on the server expires.

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22 **31.** The method as recited in claim 28, wherein sending test data
23 comprises sending a portion of the image at an initial transfer rate.

1 **32.** The method as recited in claim 28, wherein sending test data
2 comprises:
3 sending a first portion of the image at a first rate; and
4 sending a second portion of the image at a second rate.

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6 **33.** The method as recited in claim 28, wherein the test data is:
7 a selected percentage of the image;
8 a selected amount of data obtained from the image; or
9 data obtained from the image of a size calculated for transmission within a
10 selected period of time.

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12 **34.** The method as recited in claim 28, wherein the R_i values are sent
13 from at least some of the plurality of clients to the server via a UDP packet.

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15 **35.** The method as recited in claim 28, wherein sending R_i values
16 comprises:
17 setting a timer on the server to indicate a maximum period of time during
18 which the server will wait for a response from the plurality of clients; and
19 transferring data-transfer statistics from the plurality of clients to the server
20 within the maximum period.

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22 **36.** The method as recited in claim 28, wherein calculating the rate R_0
23 comprises setting the rate R_0 equal to a minimum of the R_i values for all i.

1 **37.** The method as recited in claim 28, wherein calculating the R_0
2 comprises:
3 dividing the plurality of clients into at least two groups; and
4 setting R_0 as a function of a minimum R_i associated with clients within one
5 of the at least two groups.

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7 **38.** The method as recited in claim 28, wherein calculating the R_0
8 comprises:
9 selecting one of the R_i ; and
10 setting R_0 as a function of the selected R_i , less a de-rating factor.

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12 **39.** The method as recited in claim 28, wherein calculating the rate R_0
13 comprises:
14 forming at least two groups of clients, wherein the forming is based on the
15 R_i 's of the clients;

16 selecting a smallest R_i associated with a client from within the at least two
17 groups of clients; and
18 setting R_0 as a function of the selected smallest R_i .

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20 **40.** The method as recited in claim 28, additionally comprising sending
21 the image at the rate R_0 during a first multicast session.

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23 **41.** The method as recited in claim 40, additionally comprising:
24 opening a second reliable multicast session; and
25 sending in the second multicast session at a rate less than R_0 .

1 **42.** A server, comprising:

2 means for sending test data to a plurality of clients, wherein the test data is a
3 subset of an image to be sent to the plurality of clients;

4 means for receiving a rate R_i based at least in part on a rate at which the test
5 data was received by at least one of the plurality of clients; and

6 means for calculating a rate R_0 at which to send the image to the plurality of
7 clients, wherein the rate R_0 is a function of the R_i .

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9 **43.** The server as recited in claim 42, wherein the means for sending test
10 data comprises means for operating a reliable multicast session.

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12 **44.** The server as recited in claim 42, wherein the means for calculating
13 the R_0 comprises means for setting the rate R_0 equal to a minimum value of the
14 rate R_i for all i .

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16 **45.** The server as recited in claim 42, wherein the means for calculating
17 the R_0 comprises:

18 means for dividing the plurality of clients into at least two groups; and
19 means for setting R_0 equal to a minimum R_i associated with clients within
20 one of the at least two groups.

1 **46.** The server as recited in claim 42, wherein the means for sending test
2 data is configured to send:

3 a selected percentage of the image;
4 a selected amount of data obtained from the image; or
5 data obtained from the image of a size calculated for transmission within a
6 selected period of time.

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8 **47.** The server as recited in claim 42, additionally comprising means for
9 sending the image at the rate R_0 during a first multicast session.

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11 **48.** The server as recited in claim 42, wherein the means for receiving
12 the rate R_i comprises:

13 means for setting a timer to indicate a maximum period of time during
14 which to wait for a response from the plurality of clients; and

15 means for receiving data-transfer statistics from the at least some of the
16 plurality of clients within the maximum period.

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18 **49.** The server as recited in claim 42, wherein the means for sending test
19 data comprises means for setting a timer to indicate a maximum period of time
20 during which to send the test data to the plurality of clients

1 **50.** A client, comprising:

2 means for receiving test data from a server during a reliable multicast

3 session, comprising:

4 means for receiving an initial transmission of test data comprising a
5 portion of an image at an initial transfer rate;

6 means for setting a timer; and

7 means for receiving additional test data until the timer expires;

8 means for calculating a rate R_i based at least in part on a rate at which the
9 test data was received; and

10 means for sending the rate R_i to the server.

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12 **51.** The client as recited in claim 50, wherein the means for receiving
13 test data additionally comprises:

14 means for decrypting and decompressing the received test data; and

15 means for writing the decrypted and decompressed test data to a disk.

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17 **52.** The client as recited in claim 50, wherein the means for sending the
18 rate R_i comprises means for sending data-transfer statistics including the rate R_i to
19 the server in a UDP packet.

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1 **53.** The client as recited in claim 50, wherein the means for calculating
2 the R_i comprises means for setting R_i equal to an average rate at which the test data
3 was received.

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5 **54.** The client as recited in claim 50, wherein the means for calculating
6 the rate R_i comprises means for setting the rate R_i equal to a minimum rate at
7 which the test data was received.

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9 **55.** The client as recited in claim 50, wherein the means for calculating
10 the R_i comprises:

11 means for setting the rate R_i as a function of a rate at which the test data
12 was received; and

13 means for de-rating the rate R_i to result in a safer value.

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15 **56.** The client as recited in claim 50, additionally comprising means for
16 receiving the image at a rate R_0 during a first multicast session if the rate R_0 is less
17 than the rate R_i .

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19 **57.** The client as recited in claim 50, additionally comprising instructions
20 for means for allowing the client to receive the image during a second multicast
21 session if the rate R_0 is more than the rate R_i .

1 **58.** A server, comprising:

2 a test data generation module to generate test data for transmission to a
3 plurality of clients, wherein the test data is a subset of an image to be sent to the
4 plurality of clients; and

5 an R_0 calculation module to receive a rate R_i at which the test data was
6 received by at least some of the plurality of clients and to calculate a rate R_0 at
7 which to send the image to the plurality of clients, wherein the rate R_0 is a function
8 of the rate R_i .

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10 **59.** The server as recited in claim 58, wherein the test generation module
11 is configured to send the test data to the plurality of clients by operation of a
12 reliable multicast session.

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14 **60.** The server as recited in claim 58, wherein the R_0 calculation module
15 is configured to set the rate R_0 equal to a minimum value of the rate R_i for all i .

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17 **61.** The server as recited in claim 58, wherein the R_0 calculation module
18 is additionally configured to:

19 divide the plurality of clients into at least two groups; and
20 set the rate R_0 equal to a minimal value of the rate R_i associated with clients
21 within one of the at least two groups.

1 **62.** The server as recited in claim 58, wherein the test data generation
2 module is configured to send:

3 a selected percentage of the image;
4 a selected amount of data obtained from the image; or
5 data obtained from the image of a size calculated for transmission within a
6 selected period of time.

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8 **63.** The server as recited in claim 58, additionally comprising:

9 a data communication module configured to set a timer to indicate a
10 maximum period of time during which to wait for receipt of data-transfer statistics
11 from the plurality of clients.

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13 **64.** A client, comprising:

14 a data reception module to receive test data from a server during a reliable
15 multicast session, wherein the test data reception module is additionally configured
16 to:

17 receive an initial transmission of test data comprising a portion of an
18 image at an initial transfer rate;

19 set a timer; and
20 receive additional test data until the timer expires;
21 an R_i calculation module to calculate a rate R_i based at least in part on a rate
22 at which the test data was received; and
23 an R_i management module to transmit the rate R_i to the server.

1 **65.** The client as recited in claim 64, wherein the data reception module
2 is additionally configured for:

3 decrypting and decompressing the received test data; and
4 writing the decrypted and decompressed test data to a disk.

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6 **66.** The client as recited in claim 64, wherein the R_i management module
7 transmits the rate R_i via a UDP packet to the server.

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9 **67.** The client as recited in claim 64, wherein the R_i calculation module
10 is configured to set the rate R_i equal to an average rate at which the test data was
11 received.

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13 **68.** The client as recited in claim 64, wherein the R_i calculation module
14 is configured to set the rate R_i equal to a minimum rate at which the test data was
15 received.

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17 **70.** The client as recited in claim 64, wherein the R_i calculation module
18 is configured to set the rate R_i as a function of a rate at which data was received
19 and to de-rate the rate R_i to result in a safer value.

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21 **71.** The client as recited in claim 64, wherein the data reception module
22 is configured to receive the image at a rate R_0 during a first multicast session if R_0
23 is less than R_i .

1 **72.** The client as recited in claim 64, wherein the data reception module
2 is configured to receive the image during a second multicast session if R_0 is more
3 than R_i .

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